CLAIMS

1. A vehicle with a lean and alignment control system, comprising:

a frame having a central longitudinal axis and an upright axis that is adapted to be generally perpendicular to a surface on which the vehicle rests when the frame is in a neutral position with no net leaning loads applied;

a suspension comprising a plurality of arm assemblies connected to the frame;

a mechanical feedback mechanism forming an interconnection between the frame and the suspension;

wherein each arm assembly comprises:

a lower arm having an inboard end and an outboard end;

an upper control arm having an inboard end and an outboard end; and

an actuator mounted to the lower arm and motively connected to the upper control arm.

2. The vehicle of claim 1, wherein the actuator further comprises:

an actuator arm pivotally connected to the inboard end of the upper control arm;

the actuator arm pivotally connected to the inboard end of the lower arm; and

a mechanical drive mechanism motively connected to the actuator arm to move the actuator arm through a range of motion.

3. The vehicle of claim 2, wherein the mechanical feedback mechanism comprises a position indicating cam operably associated with the arm assembly for automatically controlling the mechanical drive mechanism and the actuator arm.

4. The vehicle of claim 3, wherein:

the position indicating cam comprises an eccentric fixed to rotate with the lower arm; and

the mechanical drive mechanism comprises an actuation cylinder mounted to the frame and receiving an input from the eccentric as the lower arm moves.

5. The vehicle of claim 4, wherein the mechanical drive mechanism further comprises:

the actuation cylinder in fluid communication with a fluid driven rack and pinion; and

a fluid driven rack and pinion drivingly connected to the actuator.

6. The vehicle of claim 5, wherein the mechanical drive mechanism further comprises:

the actuation cylinder fluidly connected to the fluid driven rack and pinion by a high pressure fluid line containing a substantially noncompressible fluid; and

a fluid reservoir in the high pressure fluid line for receiving excess fluid during periods of high flow rate.

7. The vehicle of claim 6, wherein the reservoir is an expansible reservoir having an adjustable spring for adjusting an expansibility of the reservoir.

8. The vehicle of claim 5, wherein the mechanical drive mechanism further comprises:

the actuation cylinder fluidly connected to the fluid driven rack and pinion by a high pressure fluid line containing a substantially noncompressible fluid; and

a pressure control valve in the high pressure fluid line for adjusting a flow aperture through which the fluid flows.

9. The vehicle of claim 8, wherein the pressure control valve comprises a needle valve for adjusting the flow aperture and a pop off valve for releasing the fluid at pressures greater than a predetermined threshold.

10. The vehicle of claim 5, wherein the mechanical drive mechanism further comprises:

the actuation cylinder fluidly connected to a first side of the fluid driven rack and pinion by a high pressure fluid line;

the actuation cylinder fluidly connected to a second side of the fluid driven rack and pinion by a low pressure fluid line.

11. The vehicle of claim 2, wherein:

the arm assembly is a first arm assembly, the vehicle further comprising a plurality of similar arm assemblies including the first arm assembly;

the mechanical feedback mechanism is a first mechanical feedback mechanism, the vehicle further comprising a plurality of similar feedback mechanisms operatively associated with respective arm assemblies; and

each mechanical feedback mechanism comprises a position indicating cam operably associated with the respective arm assemblies for automatically controlling the mechanical drive mechanism and the actuator arm in each arm assembly.

12. The vehicle of claim 11, wherein the plurality of arm assemblies comprises:

at least a first arm assembly on a first side of the frame;

at least a second arm assembly on a second side opposite to the first side; and

wherein the mechanical feedback mechanisms automatically move the first arm assembly through a first lean angle closer to the frame and the second arm assembly away from the frame so that the first and second arm assemblies remain generally parallel to each other in response to a leaning force applied by a rider of the vehicle.

13. The vehicle of claim 11, further comprising:

at least one speed sensor operably associated with the vehicle and adapted for detecting the vehicle speed;

a mechanism for automatically adjusting an expansibility in a fluid reservoir based on the vehicle speed; and

wherein the mechanical feedback mechanisms control the fluid driven rack and pinions in each arm assembly and move the actuator arms to provide a smooth lean of the frame relative to the arm assemblies.

14. The vehicle of claim 2, further comprising:

a shock absorber having an inboard end and an outboard end;

the inboard end of the shock absorber connected to the frame; and

the outboard end of the shock absorber connected to the actuator arm.

15. The vehicle of claim 14, wherein the shock absorber is connected to the actuator arm outboard relative to a position at which the upper control arm is connected to the actuator arm.

16. The vehicle of claim 14, wherein the shock absorber moves in a range of motion between:

a first position in which the shock absorber extends in an end to end direction substantially parallel with the lower arm of a first arm assembly of the plurality of arm assemblies when the frame is leaned away from the first arm assembly; and

a second position having an angle of approximately forty-five degrees relative to the lower arm of the first arm assembly when the frame is leaned toward the first arm assembly.

17. The suspension of claim 14, wherein the outboard end of the shock absorber moves in a range of motion between a position generally above the upper control arm to a position generally below the upper control arm.

18. The vehicle of claim 2, wherein the actuator arm comprises:

a first connection comprising structure that pivotally connects the actuator arm to the lower arm;

a second connection comprising structure that pivotally connects the actuator arm to the upper control arm;

a third connection that connects a shock absorber to the actuator arm; and

wherein a line through the first connection and the second connection is at an angle in a range substantially from 0 to 90 degrees relative to a line through the first connection and the third connection.

19. The vehicle of claim 18, wherein the angle is approximately forty-five degrees.

20. The vehicle of claim 18, wherein the third connection is outboard of the second connection.

21. In a vehicle, a method of tracking a contour of a driving surface to absorb shock, the method comprising:

automatically and independently raising and lowering a plurality of arms of the vehicle suspension to accommodate variations in the contour by a mechanical mechanism;

providing feed forward by at least one mechanical shock absorber;

providing feedback via the mechanical mechanism to an actuator; and

raising and lowering the arms by the actuator according to the feedback.

22. The method of claim 21, wherein the mechanical mechanism comprises a position indicating cam fixedly supported relative to at least one of the arms, and wherein the step of providing feedback further comprises feeding back a representation of a position of the at least one of the arms by way of the cam.

23. The method of claim 21, comprising providing additional feed forward by taking up excess fluid in an expansible reservoir in fluid communication with the mechanical mechanism.

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